

## BCD-TO-7 SEGMENT LATCH/DECODER/LCD DRIVER

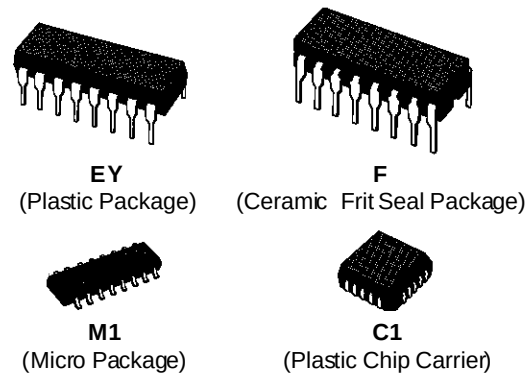
- DISPLAY BLANKING OF ALL ILLEGAL INPUT COMBINATIONS
- LATCH STORAGE OF CODE
- CAPABILITY OF DRIVING TWO LOW POWER TTL LOADS, TWO HTL LOADS, OR ONE LOW POWER SCHOTTKY LOAD OVER THE FULL RATED-TEMPERATURE RANGE
- PIN-FOR-PIN REPLACEMENT FOR THE HCF4056B (with pin 7 tied to V<sub>SS</sub>)
- DIRECT LED DRIVING CAPABILITY
- 100% TESTED FOR QUIESCENT CURRENT AT 20V
- MAXIMUM INPUT CURRENT OF 1A AT 18V OVER FULL PACKAGE-TEMPERATURE RANGE ; 100nA AT 18V AND 25°C
- NOISE MARGIN (full package-temperature range) = 1V AT V<sub>DD</sub> = 5V  
2V AT V<sub>DD</sub> = 10V  
2.5V AT V<sub>DD</sub> = 15V
- 5-V, 10-V, AND 15-V PARAMETRIC RATINGS

### Applications :

- INSTRUMENT DISPLAY DRIVER
- DASHBOARD DISPLAY DRIVER
- COMPUTER/CALCULATOR DISPLAY DRIVER
- TIMING DEVICE DRIVER (clocks, watches, timers)

## DESCRIPTION

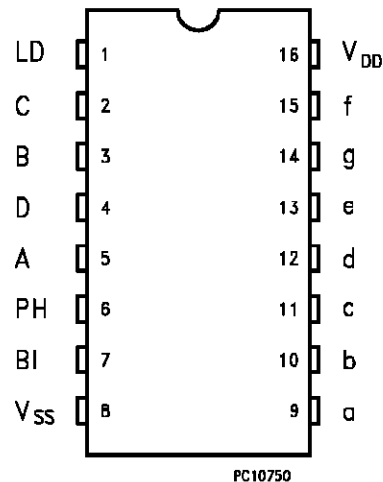
The HCC/HCF4543B is a BCD-to-seven segment latch/decoder/driver designed primarily for liquid-crystal display (LCD) applications. It is also capable of driving light emitting diode (LED), incandescent, gas-discharge, and fluorescent displays. This device is functionally similar to and serves as direct replacement for the HCF4056B when pin 7 is connected to  $V_{SS}$ . It differs from the HCF4056B in that it has a display blanking capability instead of a level-shifting function and requires only one power supply. When the HCF4056B is used in the level shifting mode, two power supplies are required. When the HCF4543B is used for LCD applications, a square wave must be applied to the PHASE input and the backplane of the LCD device. For LED applications a logic 1 is required at the PHASE input for common-cathode devices ; a logic 0 is required for common-anode devices (see truth table).



**ORDER CODES :**

|             |             |
|-------------|-------------|
| HCC4543 BF  | HCF4543 BM1 |
| HCF4543 BEY | HCF4543 BC1 |

### PIN CONNECTION (top view)

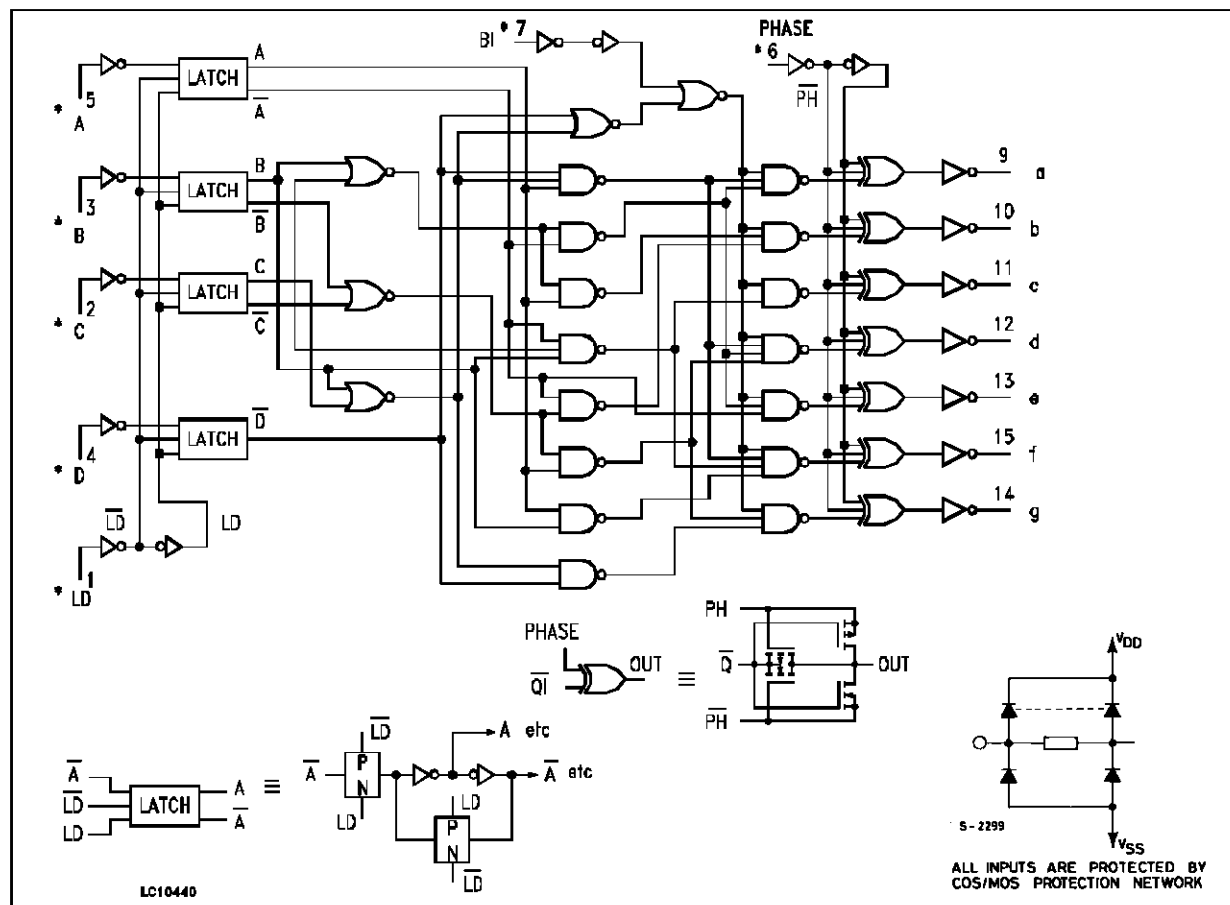


## ABSOLUTE MAXIMUM RATINGS

| Symbol     | Parameter                                                                                                                   | Value                         | Unit     |
|------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------|
| $V_{DD}^*$ | Supply voltage : <b>HCC Types</b><br><b>HCF Types</b>                                                                       | – 0.5 to + 20<br>– 0.5 to 18  | V<br>V   |
| $V_i$      | Input Voltage                                                                                                               | – 0.5 to $V_{DD} + 0.5$       | V        |
| $I_i$      | DC Input Current (any one input)                                                                                            | $\pm 10$                      | mA       |
| $P_{tot}$  | Total Power Dissipation (per package)<br>Dissipation per Output Transistor<br>for $T_{op}$ = Full Package-temperature Range | 200<br>100                    | mW<br>mW |
| $T_{op}$   | Operating Temperature : <b>HCC Types</b><br><b>HCF Types</b>                                                                | – 55 to + 125<br>– 40 to + 85 | °C<br>°C |
| $T_{stg}$  | Storage Temperature                                                                                                         | – 65 to + 150                 | °C       |

\* All Voltage Values are referred to  $V_{SS}$  pin voltage.

## LOGIC DIAGRAM (1/2 of device shown)



## RECOMMENDED OPERATING CONDITIONS

| Symbol   | Parameter                                                    | Value                         | Unit     |
|----------|--------------------------------------------------------------|-------------------------------|----------|
| $V_{DD}$ | Supply Voltage : <b>HCC Types</b><br><b>HCF Types</b>        | 3 to + 18<br>3 to + 15        | V<br>V   |
| $V_i$    | Input Voltage                                                | 0 to $V_{DD}$                 | V        |
| $T_{op}$ | Operating Temperature : <b>HCC Types</b><br><b>HCF Types</b> | – 55 to + 125<br>– 40 to + 85 | °C<br>°C |

## TRUTH TABLE

| INPUT CODE |    |     |   |   |   |   | OUTPUT STATE                         |   |   |   |   |   |   | DISPLAY CHARACTER |
|------------|----|-----|---|---|---|---|--------------------------------------|---|---|---|---|---|---|-------------------|
| LD         | BI | Ph* | D | C | B | A | a                                    | b | c | d | e | f | g |                   |
| X          | 1  | 0   | X | X | X | X | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 |                   |
| 1          | 0  | 0   | 0 | 0 | 0 | 0 | 1                                    | 1 | 1 | 1 | 1 | 1 | 0 | 0                 |
| 1          | 0  | 0   | 0 | 0 | 0 | 1 | 0                                    | 1 | 1 | 0 | 0 | 0 | 0 | 1                 |
| 1          | 0  | 0   | 0 | 0 | 1 | 0 | 1                                    | 1 | 0 | 1 | 1 | 0 | 1 | 2                 |
| 1          | 0  | 0   | 0 | 0 | 1 | 1 | 1                                    | 1 | 1 | 1 | 0 | 0 | 1 | 3                 |
| 1          | 0  | 0   | 0 | 1 | 0 | 0 | 0                                    | 1 | 1 | 0 | 0 | 1 | 1 | 4                 |
| 1          | 0  | 0   | 0 | 1 | 0 | 1 | 1                                    | 0 | 1 | 1 | 0 | 1 | 1 | 5                 |
| 1          | 0  | 0   | 0 | 1 | 1 | 0 | 1                                    | 0 | 1 | 1 | 1 | 1 | 1 | 6                 |
| 1          | 0  | 0   | 0 | 1 | 1 | 1 | 1                                    | 1 | 1 | 0 | 0 | 0 | 0 | 7                 |
| 1          | 0  | 0   | 1 | 0 | 0 | 0 | 1                                    | 1 | 1 | 1 | 1 | 1 | 1 | 8                 |
| 1          | 0  | 0   | 1 | 0 | 0 | 1 | 1                                    | 1 | 1 | 1 | 0 | 1 | 1 | 9                 |
| 1          | 0  | 0   | 1 | 0 | 1 | 0 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1          | 0  | 0   | 1 | 0 | 1 | 1 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1          | 0  | 0   | 1 | 1 | 0 | 0 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1          | 0  | 0   | 1 | 1 | 0 | 1 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1          | 0  | 0   | 1 | 1 | 1 | 0 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1          | 0  | 0   | 1 | 1 | 1 | 1 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 0          | 0  | 0   | X | X | X | X | **                                   |   |   |   |   |   |   | **                |
| •          | •  | •   | • |   |   |   | Inverse of Output Combinations Above |   |   |   |   |   |   | Display as above  |

X = Don't care.

• = Above combinations

\* = For liquid-crystal readouts, apply a square wave to Ph.

For common cathode LED readouts, select Ph = 0.

For common anode LED readouts, select Ph = 1.

\*\* = Depends upon the BCD code previously applied when LD = 1.

## STATIC ELECTRICAL CHARACTERISTICS

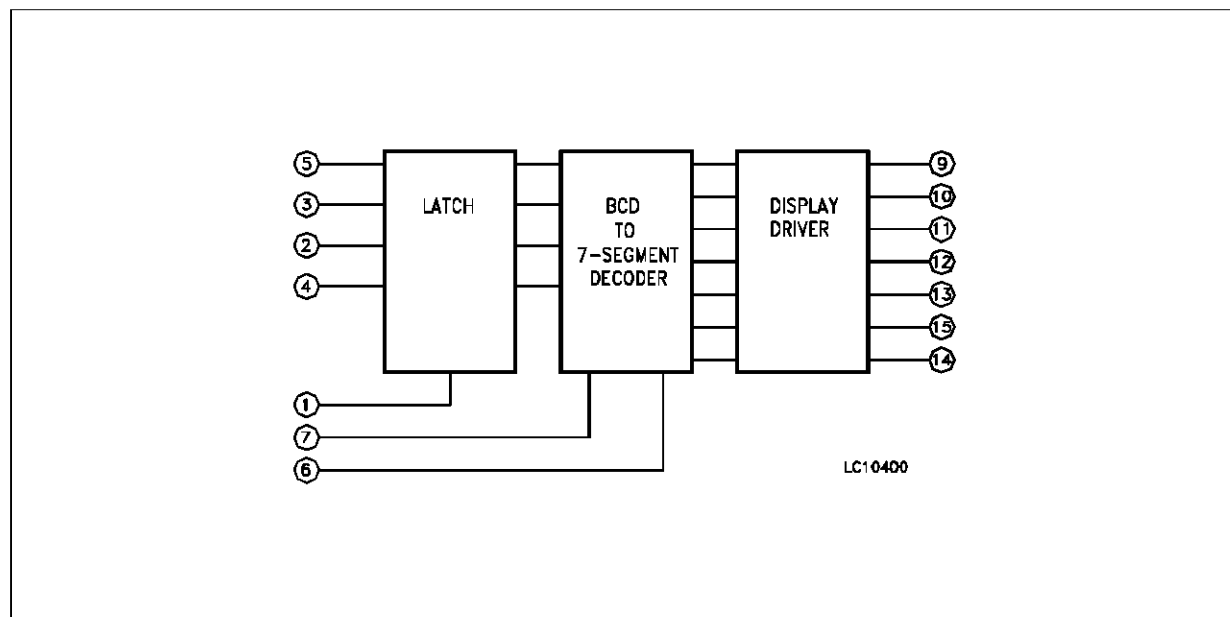
| Symbol                            | Parameter             |           | Test Conditions       |                       |                        |                        | Value            |       |        |                    |       |                   |      | Unit |
|-----------------------------------|-----------------------|-----------|-----------------------|-----------------------|------------------------|------------------------|------------------|-------|--------|--------------------|-------|-------------------|------|------|
|                                   |                       |           | V <sub>I</sub><br>(V) | V <sub>O</sub><br>(V) | I <sub>O</sub><br>(μA) | V <sub>DD</sub><br>(V) | T <sub>Low</sub> |       | 25°C   |                    |       | T <sub>High</sub> |      |      |
|                                   |                       |           |                       |                       |                        |                        | Min.             | Max.  | Min.   | Typ.               | Max.  | Min.              | Max. |      |
| I <sub>L</sub>                    | Quiescent Current     | HCC Types | 0/5                   |                       |                        | 5                      |                  | 5     |        | 0.04               | 5     |                   | 150  | μA   |
|                                   |                       |           | 0/10                  |                       |                        | 10                     |                  | 10    |        | 0.04               | 10    |                   | 300  |      |
|                                   |                       |           | 0/15                  |                       |                        | 15                     |                  | 20    |        | 0.04               | 20    |                   | 600  |      |
|                                   |                       |           | 0/20                  |                       |                        | 20                     |                  | 100   |        | 0.08               | 100   |                   | 3000 |      |
|                                   |                       | HCF Types | 0/5                   |                       |                        | 5                      |                  | 5     |        | 0.04               | 5     |                   | 150  |      |
|                                   |                       |           | 0/10                  |                       |                        | 10                     |                  | 10    |        | 0.04               | 10    |                   | 300  |      |
|                                   |                       |           | 0/15                  |                       |                        | 15                     |                  | 20    |        | 0.04               | 20    |                   | 600  |      |
| V <sub>OH</sub>                   | Output High Voltage   | 0/5       |                       | < 1                   | 5                      | 4.95                   |                  | 4.95  |        |                    | 4.95  |                   | V    |      |
|                                   |                       | 0/10      |                       | < 1                   | 10                     | 9.95                   |                  | 9.95  |        |                    | 9.95  |                   |      |      |
|                                   |                       | 0/15      |                       | < 1                   | 15                     | 14.95                  |                  | 14.95 |        |                    | 14.95 |                   |      |      |
| V <sub>OL</sub>                   | Output Low Voltage    | 5/0       |                       | < 1                   | 5                      |                        | 0.05             |       |        | 0.05               |       | 0.05              | V    |      |
|                                   |                       | 10/0      |                       | < 1                   | 10                     |                        | 0.05             |       |        | 0.05               |       | 0.05              |      |      |
|                                   |                       | 15/0      |                       | < 1                   | 15                     |                        | 0.05             |       |        | 0.05               |       | 0.05              |      |      |
| V <sub>IH</sub>                   | Input High Voltage    |           | 0.5/4.5               | < 1                   | 5                      | 3.5                    |                  | 3.5   |        |                    | 3.5   |                   | V    |      |
|                                   |                       |           | 1/9                   | < 1                   | 10                     | 7                      |                  | 7     |        |                    | 7     |                   |      |      |
|                                   |                       |           | 1.5/13.5              | < 1                   | 15                     | 11                     |                  | 11    |        |                    | 11    |                   |      |      |
| V <sub>IL</sub>                   | Input Low Voltage     |           | 4.5/0.5               | < 1                   | 5                      |                        | 1.5              |       |        | 1.5                |       | 1.5               | V    |      |
|                                   |                       |           | 9/1                   | < 1                   | 10                     |                        | 3                |       |        | 3                  |       | 3                 |      |      |
|                                   |                       |           | 13.5/1.5              | < 1                   | 15                     |                        | 4                |       |        | 4                  |       | 4                 |      |      |
| I <sub>OH</sub>                   | Output Drive Current  | HCC Types | 0/5                   | 2.5                   |                        | 5                      | − 1.6            |       | − 1.3  | − 2.6              |       | − 0.9             |      | mA   |
|                                   |                       |           | 0/5                   | 4.6                   |                        | 5                      | − 0.46           |       | − 0.37 | − 0.75             |       | − 0.26            |      |      |
|                                   |                       |           | 0/10                  | 9.5                   |                        | 10                     | − 0.98           |       | − 0.8  | − 1.6              |       | − 0.55            |      |      |
|                                   |                       |           | 0/15                  | 13.5                  |                        | 15                     | − 3.33           |       | − 2.7  | − 5.4              |       | − 1.9             |      |      |
|                                   |                       | HCF Types | 0/5                   | 2.5                   |                        | 5                      | 1.3              |       | − 1.1  | − 2.6              |       | − 0.9             |      |      |
|                                   |                       |           | 0/5                   | 4.6                   |                        | 5                      | 0.36             |       | − 0.31 | − 0.75             |       | − 0.25            |      |      |
|                                   |                       |           | 0/10                  | 9.5                   |                        | 10                     | 0.81             |       | − 0.68 | − 1.6              |       | − 0.54            |      |      |
| I <sub>OL</sub>                   | Output Sink Current   | HCC Types | 0/5                   | 0.4                   |                        | 5                      | 0.64             |       | 0.51   | 1                  |       | 0.36              |      | mA   |
|                                   |                       |           | 0/10                  | 0.5                   |                        | 10                     | 1.6              |       | 1.3    | 2.6                |       | 0.9               |      |      |
|                                   |                       |           | 0/15                  | 1.5                   |                        | 15                     | 4.2              |       | 3.4    | 6.8                |       | 2.4               |      |      |
|                                   |                       | HCF Types | 0/5                   | 0.4                   |                        | 5                      | 0.52             |       | 0.44   | 1                  |       | 0.36              |      |      |
|                                   |                       |           | 0/10                  | 0.5                   |                        | 10                     | 1.3              |       | 1.1    | 2.6                |       | 0.9               |      |      |
|                                   |                       |           | 0/15                  | 1.5                   |                        | 15                     | 3.6              |       | 3.0    | 6.8                |       | 2.4               |      |      |
| I <sub>IH</sub> , I <sub>IL</sub> | Input Leakage Current | HCC types | 0/18                  | Any Input             |                        | 18                     |                  | ± 0.1 |        | ± 10 <sup>−5</sup> | ± 0.1 |                   | ± 1  | μA   |
|                                   |                       | HCF types | 0/15                  |                       |                        | 15                     |                  | ± 0.3 |        | ± 10 <sup>−5</sup> | ± 0.3 |                   | ± 1  |      |

\* T<sub>Low</sub> = - 55°C for HCC device : - 40°C for HCF device.\* T<sub>High</sub> = + 125°C for HCC device : + 85°C for HCF device.The Noise Margin for both "1" and "0" level is : 1V min. with V<sub>DD</sub> = 5V, 2V min. with V<sub>DD</sub> = 10V, 2.5V min. with V<sub>DD</sub> = 15V.

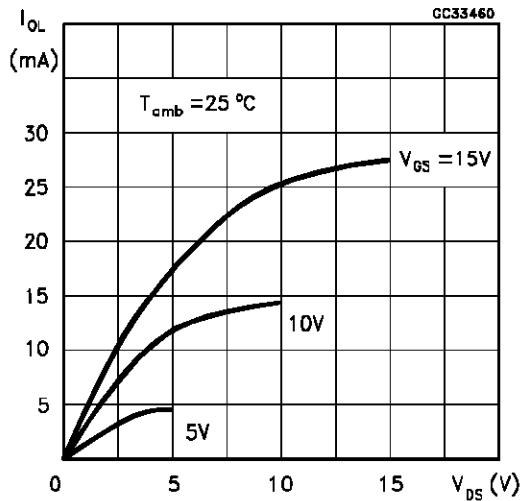
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$ , typical temperature coefficient for all  $V_{DD}$  values is  $0.3\%/^{\circ}\text{C}$ , all input rise and fall time =  $20\text{ns}$ )

| Symbol    | Parameter                 | Test Conditions<br>$V_{DD}$ (V) | Limits<br>All packages |      |      | Unit |
|-----------|---------------------------|---------------------------------|------------------------|------|------|------|
|           |                           |                                 | Min.                   | Typ. | Max. |      |
| $t_{PHL}$ | Propagation Delay Time    | 5                               |                        | 600  | 1200 | ns   |
|           |                           | 10                              |                        | 200  | 400  |      |
|           |                           | 15                              |                        | 150  | 300  |      |
| $t_{PLH}$ |                           | 5                               |                        | 500  | 1000 |      |
|           |                           | 10                              |                        | 200  | 400  |      |
|           |                           | 15                              |                        | 150  | 300  |      |
| $t_{THL}$ | Transition Time           | 5                               |                        | 180  | 360  | ns   |
|           |                           | 10                              |                        | 90   | 180  |      |
|           |                           | 15                              |                        | 65   | 130  |      |
| $t_{TLH}$ |                           | 5                               |                        | 180  | 360  |      |
|           |                           | 10                              |                        | 90   | 180  |      |
|           |                           | 15                              |                        | 65   | 130  |      |
| $t_{WH}$  | Latch Disable Pulse Width | 5                               | 250                    | 125  |      |      |
|           |                           | 10                              | 100                    | 50   |      |      |
|           |                           | 15                              | 80                     | 40   |      |      |
| $t_{SU}$  | Address Setup Time        | 5                               | 60                     | 15   |      |      |
|           |                           | 10                              | 20                     | - 5  |      |      |
|           |                           | 15                              | 10                     | - 5  |      |      |
| $t_H$     | Address Hold Time         | 5                               | 25                     | -5   |      |      |
|           |                           | 10                              | 20                     | 10   |      |      |
|           |                           | 15                              | 20                     | 0    |      |      |
| $C_{IN}$  | Input Capacitance         | Any Input                       |                        | 5    | 7.5  | pF   |

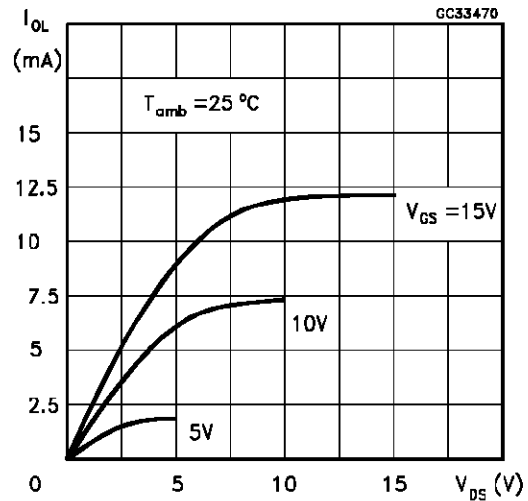
BCD-to-seven-segment latch/decoder/driver functional diagram



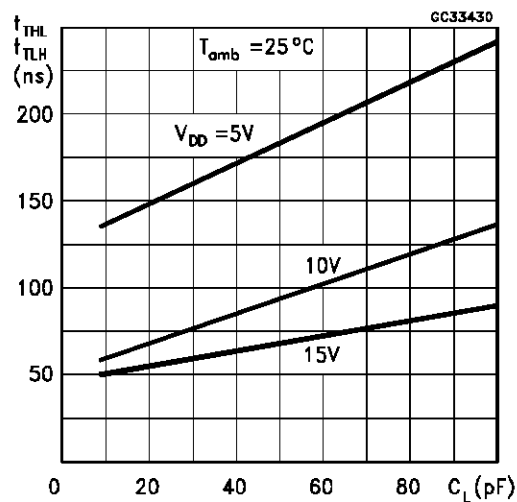
Typical Output Low (sink) Current Characteristics.



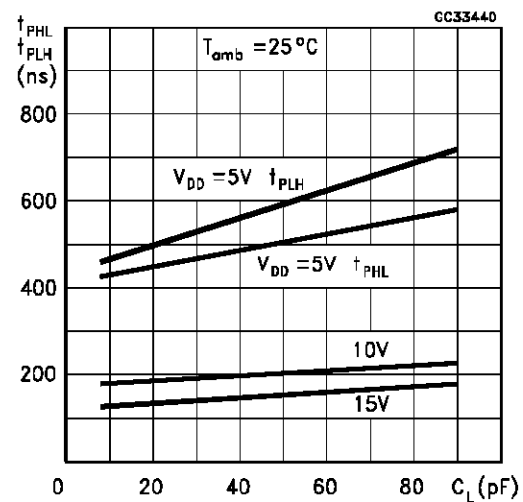
Minimum Output Low (sink) Current Characteristics.



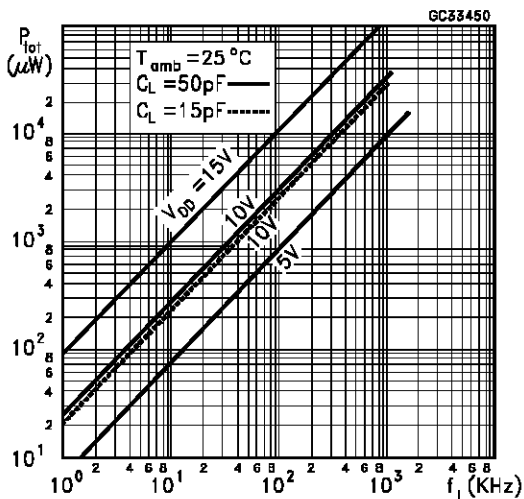
Typical Transition Time as a Function of Load Capacitance



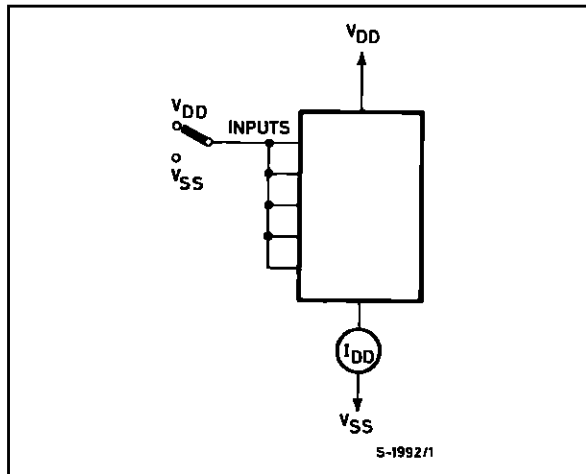
Typical Propagation Delay Time as a Function of Load Capacitance



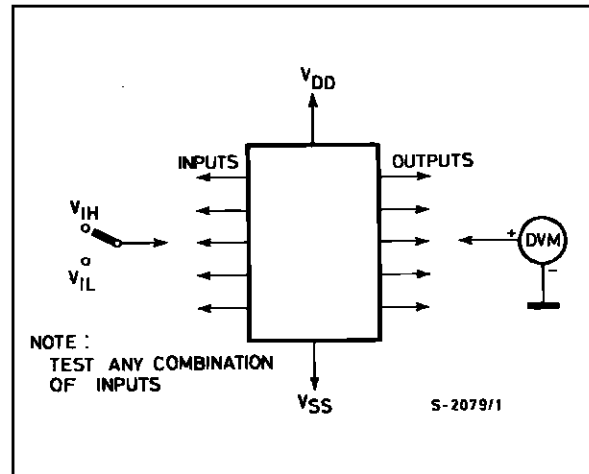
Typical Dynamic Power Dissipation as a Function of Frequency



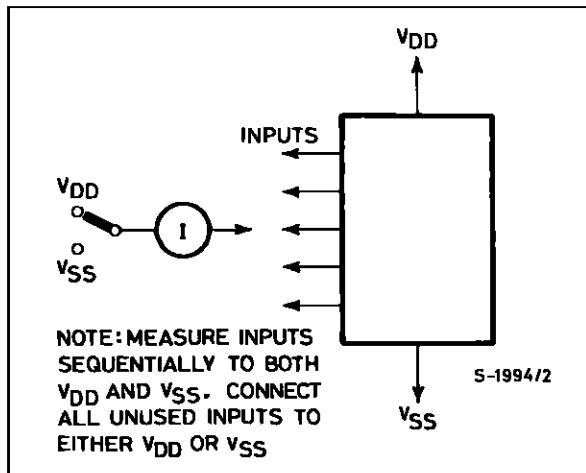
Input Voltage Test Circuit.



Quiescent Device Current Test Circuit.

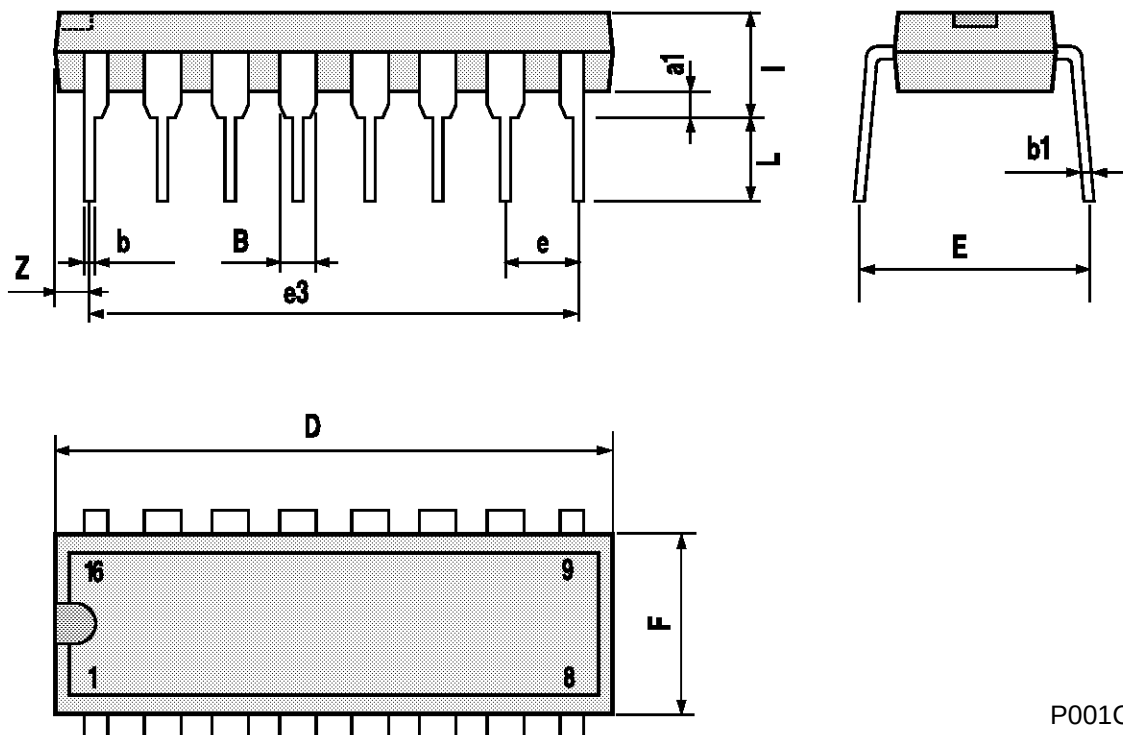


Input-leakage -current Test Circuit.



## Plastic DIP16 (0.25) MECHANICAL DATA

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |

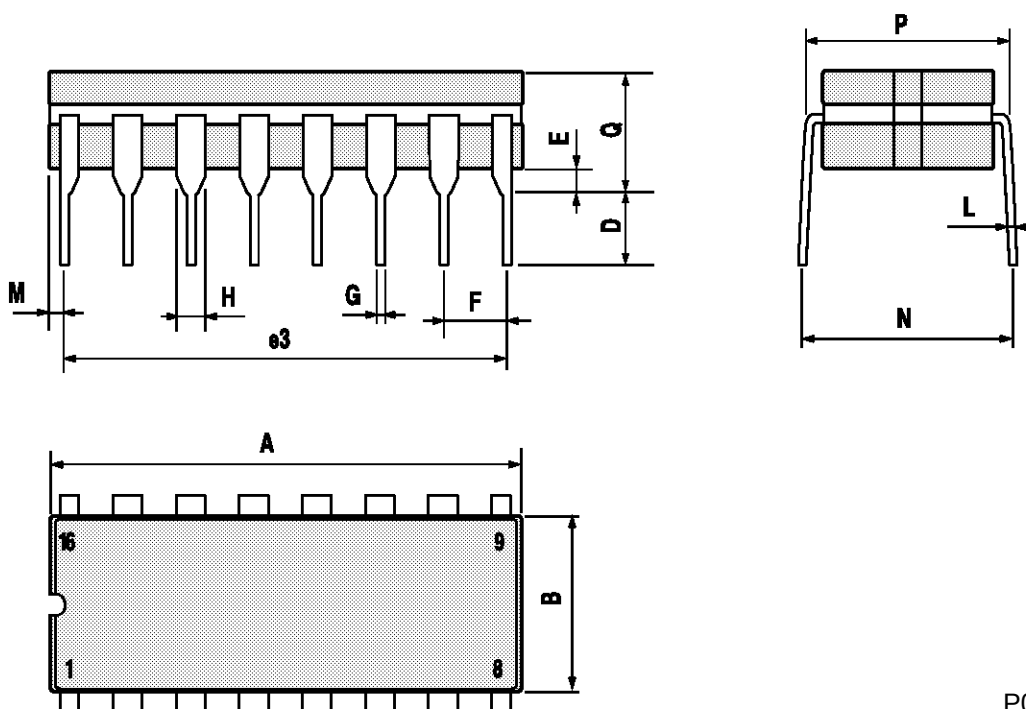


P001C



## Ceramic DIP16/1 MECHANICAL DATA

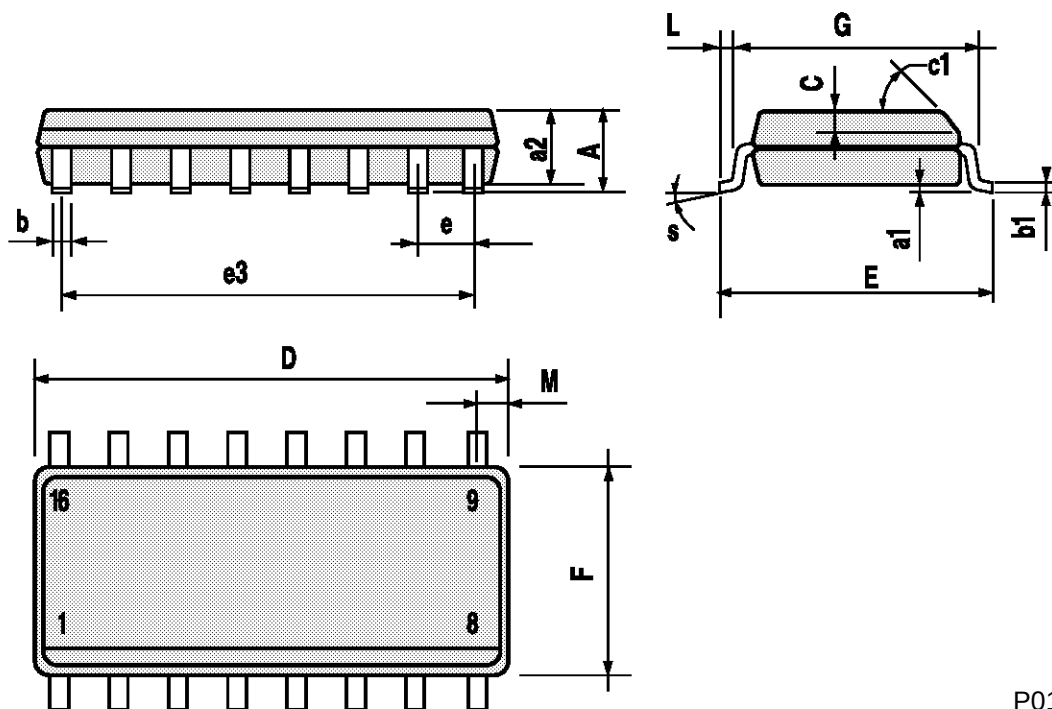
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |      |       | 0.130 |       |
| E    | 0.38 |       |      | 0.015 |       |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    | 2.29 |       | 2.79 | 0.090 |       | 0.110 |
| G    | 0.4  |       | 0.55 | 0.016 |       | 0.022 |
| H    | 1.17 |       | 1.52 | 0.046 |       | 0.060 |
| L    | 0.22 |       | 0.31 | 0.009 |       | 0.012 |
| M    | 0.51 |       | 1.27 | 0.020 |       | 0.050 |
| N    |      |       | 10.3 |       |       | 0.406 |
| P    | 7.8  |       | 8.05 | 0.307 |       | 0.317 |
| Q    |      |       | 5.08 |       |       | 0.200 |



P053D

## SO16 (Narrow) MECHANICAL DATA

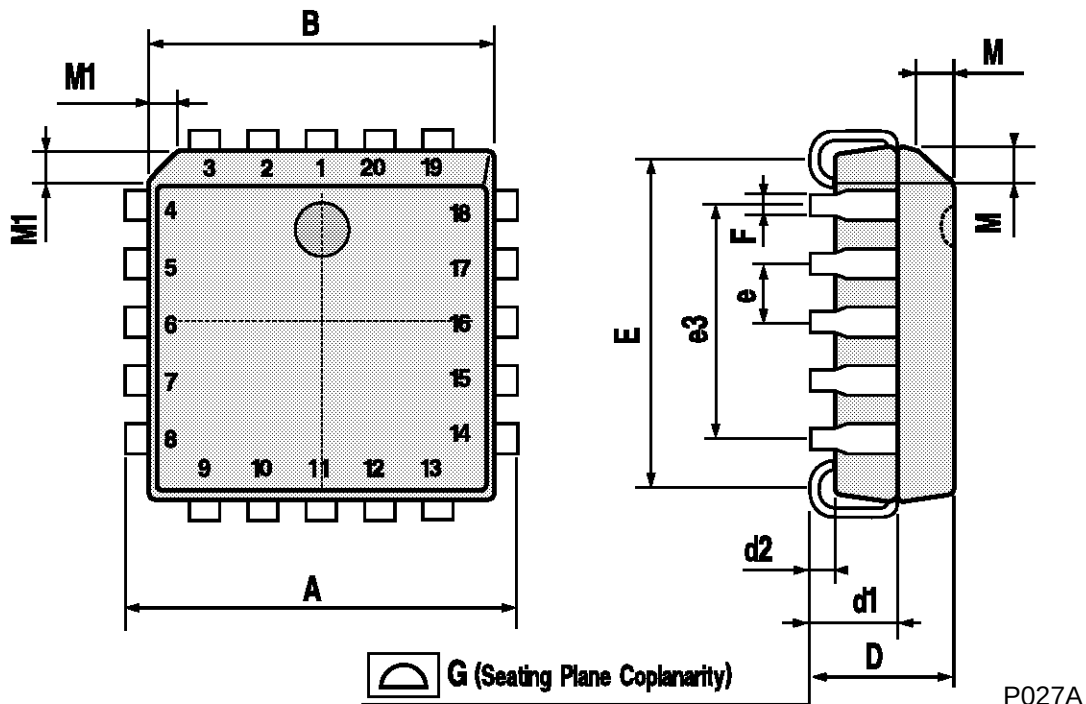
| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004 |       | 0.007 |
| a2   |            |      | 1.65 |       |       | 0.064 |
| b    | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1   | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C    |            | 0.5  |      |       | 0.019 |       |
| c1   | 45° (typ.) |      |      |       |       |       |
| D    | 9.8        |      | 10   | 0.385 |       | 0.393 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 8.89 |      |       | 0.350 |       |
| F    | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G    | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L    | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M    |            |      | 0.62 |       |       | 0.024 |
| S    | 8° (max.)  |      |      |       |       |       |



P013H

## PLCC20 MECHANICAL DATA

| DIM. | mm   |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 9.78 |      | 10.03 | 0.385 |       | 0.395 |
| B    | 8.89 |      | 9.04  | 0.350 |       | 0.356 |
| D    | 4.2  |      | 4.57  | 0.165 |       | 0.180 |
| d1   |      | 2.54 |       |       | 0.100 |       |
| d2   |      | 0.56 |       |       | 0.022 |       |
| E    | 7.37 |      | 8.38  | 0.290 |       | 0.330 |
| e    |      | 1.27 |       |       | 0.050 |       |
| e3   |      | 5.08 |       |       | 0.200 |       |
| F    |      | 0.38 |       |       | 0.015 |       |
| G    |      |      | 0.101 |       |       | 0.004 |
| M    |      | 1.27 |       |       | 0.050 |       |
| M1   |      | 1.14 |       |       | 0.045 |       |



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